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# (54) Iron with heating provided by printed tracks

(57) An electric clothes iron has a sole plate 1 formed of a steel plate having a heating element on a surface 5 in the form of resistive element tracks 7 of a thick film printed circuit 6. The tracks 7 preferably comprise left and right hand track portions 8, 9 and a water heating track portion 10 which are independently controlled. Preferably temperature sensing resistive tracks 20 and 23 allow separate sensing of the temperatures of the ironing portion of the sole plate and the water heating portion. Left and right hand track portions 8 and 9 which heat the ironing portion of the sole plate may be formed of materials having positive temperature co-efficient such that the relative currents through the left and right hand tracks is self adjusting to take account of uneven heat loss.

FIG. 1.

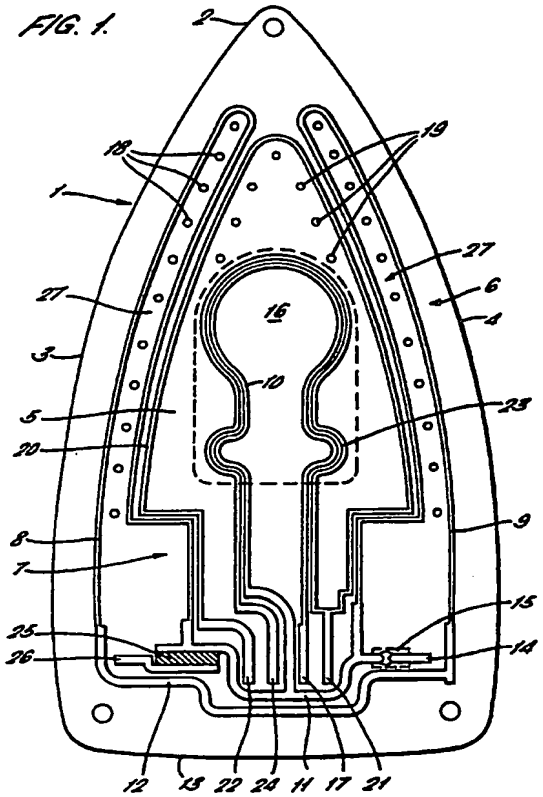


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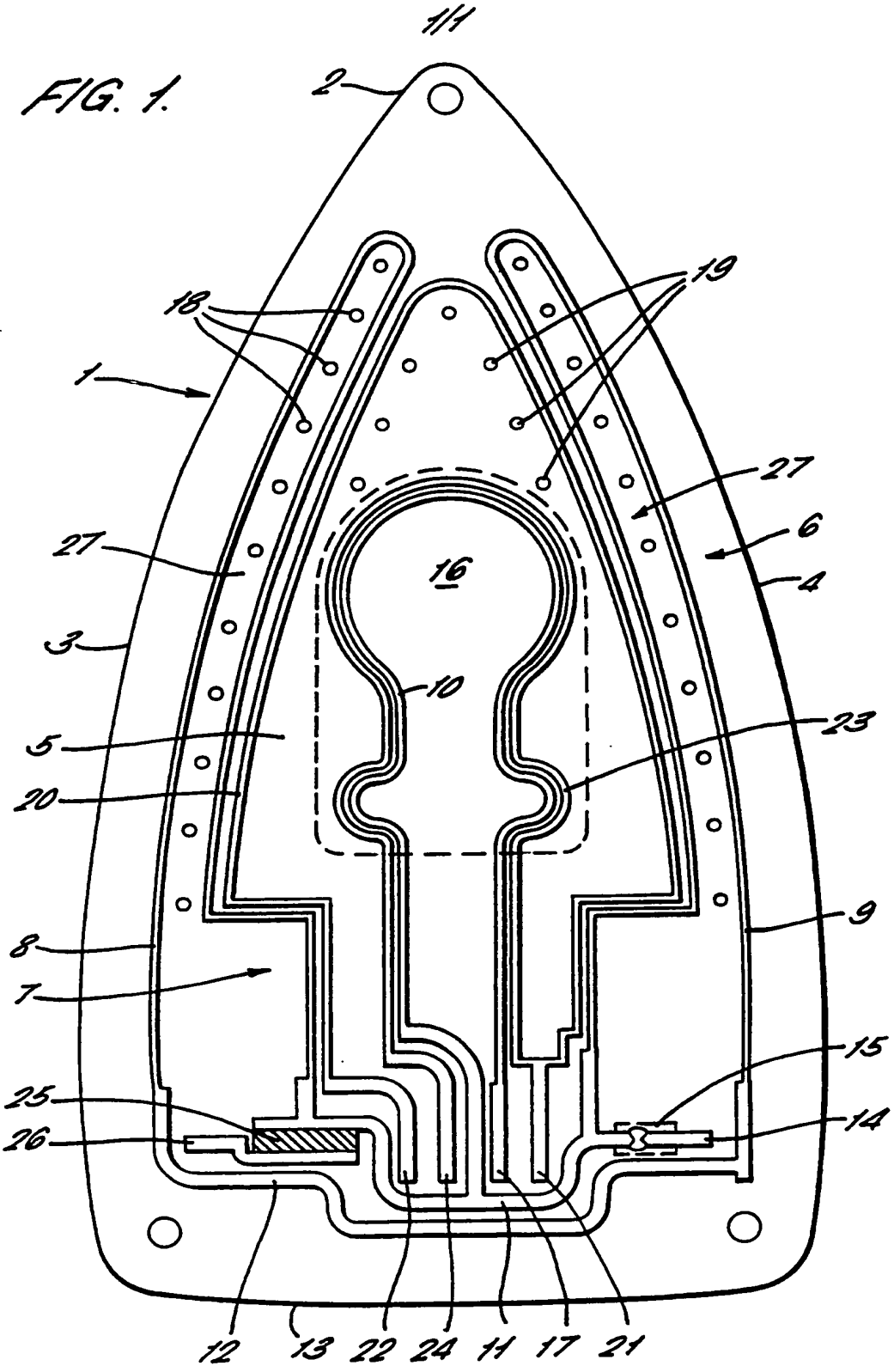
FIG. 1.



"ELECTRIC IRON"

This invention relates to an electric iron and in particular but not exclusively to a domestic steam iron for use in ironing clothes and the like.

Electric irons typically comprise a steel sole plate having a smooth lower surface for ironing and an upper surface which is recessed to accommodate an electrical resistance heating element. The heating element is typically formed integrally with the sole plate by filling the recess with a suitable encapsulating material. Current to the heating element is then controlled using a simple mechanical temperature switch using for example a bimetallic strip.

A disadvantage of such irons is that in use a significant temperature gradient may be established between the left-hand and right-hand sides of the sole plate if for example the iron is used for an extended period to iron the edge of an article where only the left or right-hand side of the iron is used to contact the article being ironed. Heat is dissipated from the iron particularly where heavy damp articles are being ironed. Typically a temperature variation of 60$^{o}$C may be exhibited.

Under such conditions effective temperature control of the sole plate cannot be achieved.

A further difficulty is that many domestic irons are provided with a steam facility which allows steam to be selectively delivered through apertures in the sole plate during the ironing process. A central portion of the sole plate is typically used to heat the water for providing steam and this process contributes to the lack of temperature uniformity across the sole plate due to cooling of the central portion when steam is being provided.

According to the present invention there is disclosed an electric iron comprising a sole plate and an electric heating element operable to heat the sole plate, wherein the heating element comprises a resistive track of a thick film printed circuit fabricated on a steel substrate constituted by the sole plate.

An advantage of such an arrangement is that improved thermal coupling is achieved between the sole plate and the heating element thereby facilitating closer temperature control of the sole plate under conditions of changing thermal load. Assembly of the sole plate is also simplified and the number of components reduced.

Preferably the sole plate defines a water heating surface of a steam producing means, the track comprising a water heating track portion operable to heat the water heating surface and a peripheral track portion operable to heat a peripheral surface portion of the sole plate which is peripheral to the water heating surface.

Preferably the supply circuit is operable to independently control the current supplied to the water heating track portion and the peripheral track portion.

The input of heat to the sole plate can thereby be adapted to take account of whether the steam facility has been selected.

Preferably the peripheral track portion comprises left and right-hand track portions formed on left and right-hand surface portions respectively of the sole plate and the supply circuit is connected respectively to the left and right-hand track portions for the supply of respective heating currents.

The respective heating currents may be controlled by the supply circuit so as to be

independently variable to take account of uneven thermal loading of the sole plate in use.

Conveniently the track comprises a resistive material having a positive temperature coefficient of resistance and wherein the left and right-hand track portions are connected in parallel to common supply terminals of the supply circuit.

The distribution of current between the left and right-hand track portions is thereby automatically varied according to the temperature dependent resistive load presented by the track to the supply circuit.

Advantageously the left and right-hand track portions comprise respective loops of the track extending along side respective left and right-hand edges of the sole plate.

Conveniently the sole plate defines an array of apertures communicating with the steam producing means for the release of steam and wherein at least some of the apertures are located within areas bounded by the left and right-hand loops.

Conveniently the thick film circuit comprises a first temperature sensing resistive track extending in proximity with the peripheral track portion and connected to the supply circuit whereby the supply circuit is operable to control the operating temperature of the peripheral surface portion by regulating current in the peripheral track portion.

Conveniently the thick film circuit comprises a second temperature sensing resistive track extending in proximity with the water heating track portion and connected to the supply circuit whereby the supply circuit is operable to independently control the operating temperature of the water heating surface by regulating current in the water heating track portion.

Preferably the steam producing means comprises

a water dispensing valve operatively connected to the supply circuit such that the water heating track portion is energised when the valve is actuated to deliver water to the water heating surface.

This arrangement ensures that heat is supplied to the water heating track portion only when the steam facility is selected and reduces the tendency for the temperature distribution of the sole plate to be affected by the selection of steam.

Conveniently the thick film printed circuit comprises a dropping resistor operable to provide a reduced voltage for powering current controlling components of the supply circuit.

This arrangement further reduces the number of components in the completed iron.

Conveniently the thick film printed circuit comprises a thermal fuse operable to turn off the supply of current in response to excess temperature being sensed.

A preferred embodiment of the present invention will now be described by way of example only and with reference to the accompanying drawing in which:-

Figure 1 is a plan view of the upper surface of a sole plate of an electric iron in accordance with the present invention.

A sole plate 1 as shown in Figure 1 is in the form of an elongate steel plate with a pointed forward end 2 formed at the convergence of curved left and right edges 3 and 4 respectively. A flat upper surface 5 of the sole plate 1 constitutes a substrate for a thick film circuit 6 which is applied to the upper surface by a screen printing process using conventional thick film inks.

The thick film circuit 6 includes resistive element tracks 7 formed by printing and firing high resistivity conductor paste during the thick film

fabrication process and comprising a left-hand track portion 8, a right-hand track portion 9 and a water heating track portion 10. The left and right-hand track portions 8 and 9 respectively are in the shape of elongate loops which extend parallel to and in proximity with the left and right-hand edges 3 and 4 respectively and are supplied with current by conductor tracks 11 and 12 which are located adjacent a rear end 13 of the sole plate (the term "conductor track" being used to denote a thickened portion of track in which heat dissipation is insignificant in comparison with that developed in the narrower element tracks 7).

The first conductor track 11 is connected to a live terminal 14 of a supply circuit (not shown) via a thermal fuse 15. The second conductor track 12 is connected to a neutral terminal of the supply circuit.

The left and right-hand track portions 8 and 9 are connected in parallel across the same live and neutral terminals and, provided all parts of the sole plate are at an even temperature, present equal resistive loads to the supply circuit and thereby draw equal currents.

The water heating track portion 10 extends in a loop around the water heating surface 16 of the sole plate and is energised by connection between the live first conductor track 11 and a third conductor track 17 which is connected to the supply circuit in a manner facilitating independent control of current through the water heating track portion.

The water heating surface 16 of the sole plate 1 forms part of a steam producing means (not shown) which operates by delivering water from a reservoir via a water dispensing valve into contact with the water heating surface such that when heated it produces steam. The sole plate is provided with an

array of apertures 18 communicating with the steam producing means and through which steam escapes in use as an aid to the ironing efficiency of the iron.

Each of the left and right-hand track portions 8 and 9 define loops which enclose areas within which respective linear arrays of apertures 18 are provided so that the heating effect of the left and right-hand track portions is applied to the sole plate immediately adjacent apertures through which steam is delivered.

Further apertures 19 are provided in an area intermediate the left and right-hand track portions 8 and 9 and the water heating track portion 10.

A first temperature sensing resistive track 20 extends in close proximity with the left and right-hand track portions 8 and 9 and terminates in conductor tracks 21 and 22 which are connected to the supply circuit to allow a temperature feedback signal to be generated for controlling the temperature of the sole plate.

A second temperature sensing resistive track 23 extends in close proximity with the water heating track portion 10 and similarly is connected to connector tracks 21 and 24 to provide a temperature feedback signal for the control of the temperature of the water heating surface 16.

A dropping resistor 25 is also printed on the thick film circuit 6 to provide connection between a live first conductor track 11 and a further connector track 26 from which a reduced power supply voltage is taken for powering the supply circuit control components.

A peripheral surface portion 27 of the sole plate 1 is heated by energising the left and right-hand track portions 8 and 9 under the control of the supply circuit, a common voltage being applied to

the track portions which are connected in parallel. The required ironing temperature of the sole plate 1 is input to the supply circuit using a conventional temperature control dial and the supply circuit regulates current in the left and right-hand track portions 8 and 9 to achieve the desired temperature by using the temperature feedback signal obtained from the first temperature sensing resistive track 20.

If in use the underside of the sole plate is applied unevenly to an article such that for example the left-hand side of the sole plate 1 is used in preference to the right-hand side, then heat loss from the left-hand side of the sole plate will tend to produce an uneven temperature distribution from left to right across the sole plate. The resistive material forming the resistive tracks 7 is selected to have a positive temperature coefficient of resistance such that any drop in temperature results in a lowering of the resistive load presented by the left-hand track portion relative to that of the right-hand. Current is then preferentially drawn into the left-hand track portion thereby enhancing the heat dissipated into the left-hand side of the sole plate 1 and tending to reduce the difference in temperature. In this way the difference in temperature between the left and right-hand sides of the sole plate will typically be no more than $10^{o}C$.

When it is required by the user for steam to be delivered through the apertures 18 and 19, the user actuates a water dispensing valve which delivers water into contact with the water heating surface 16. The valve is operatively connected to a switch of the supply circuit which energises the water heating track portion 10 thereby rapidly heating the water heating surface 16 to produce steam. The temperature of the water heating surface 16 is controlled by the supply

circuit in response to temperature feedback signals derived from the second temperature sensing resistive track 23. The provision of the separately energisable water heating track portion 10 means that the temperature of the peripheral surface portion 27 of the sole plate 1 is substantially independent of whether steam is selected by the user.

CLAIMS:

1. An electric iron comprising a sole plate, an electric heating element operable to heat the sole plate and an electrical supply circuit connected to the heating element wherein the heating element comprises a resistive track of a thick film printed circuit fabricated upon a steel substrate constituted by the sole plate.

2. An electric iron as claimed in claim 1 wherein the sole plate defines a water heating surface of a steam producing means, the track comprising a water heating track portion operable to heat the water heating surface and a peripheral track portion operable to heat a peripheral surface portion of the sole plate which is peripheral to the water heating surface.

3. An electric iron as claimed in claim 2 wherein the supply circuit is operable to independently control the current supplied to the water heating track portion and the peripheral track portion.

4. An electric iron as claimed in any of claims 2 and 3 wherein the peripheral track portion comprises left and right-hand track portions formed on left and right-hand surface portions respectively of the sole plate and the supply circuit is connected respectively to the left and right-hand track portions for the supply of respective heating currents.

5. An electric iron as claimed in claim 4 wherein the track comprises a resistive material having a positive temperature coefficient of

resistance and wherein the left and right-hand track portions are connected in parallel to common supply terminals of the supply circuit.

6. An electric iron as claimed in any of claims 4 and 5 wherein the left and right-hand track portions comprise respective loops of the track extending along side respective left and right-hand edges of the sole plate.

7. An electric iron as claimed in claim 6 wherein the sole plate defines an array of apertures communicating with the steam producing means for the release of steam and wherein at least some of the apertures are located within areas bounded by the left and right-hand loops.

8. An electric iron as claimed in any of claims 2 to 7 wherein the thick film circuit comprises a first temperature sensing resistive track extending in proximity with the peripheral track portion and connected to the supply circuit whereby the supply circuit is operable to control the operating temperature of the peripheral surface portion by regulating current in the peripheral track portion.

9. An electric iron as claimed in claim 8 wherein the thick film circuit comprises a second temperature sensing resistive track extending in proximity with the water heating track portion and connected to the supply circuit whereby the supply circuit is operable to independently control the operating temperature of the water heating surface by regulating current in the water heating track portion.

10. An electric iron as claimed in any of

claims 2 to 9 wherein the steam producing means comprises a water dispensing valve operatively connected to the supply circuit such that the water heating track portion is energised when the valve is actuated to deliver water to the water heating surface.

11. An electric iron as claimed in any preceding claim wherein the thick film printed circuit comprises a dropping resistor operable to provide a reduced voltage for powering current controlling components of the supply circuit.

12. An electric iron as claimed in any preceding claim wherein the thick film printed circuit comprises a thermal fuse operable to turn off the supply of current in response to excess temperature being sensed.

13. An electric iron substantially as hereinbefore described with reference to and as shown in the accompanying drawing.

**Patents Act 1977**
**Examiner's report to the Comptroller under section 17 (The Search Report)** 12

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**Relevant Technical fields**

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**Search Examiner**
T M JAMES

**Databases** (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

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25 NOVEMBER 1992

**Documents considered relevant following a search in respect of claims** 1-13

| Category (see over) | Identity of document and relevant passages | Relevant to claim(s) |
|---|---|---|
| X | GB 2153190 A (EMI) See Figures 2 and 4, page 1 lines 36-48 and page 3 lines 18-21 | 1 at least |
| X | EP 0158779 (STIFTUNG) See Figures 1 and 2 | 1 at least |

| Category | Identity of document and relevant passages | Relevant to claim(s) |
|---|---|---|
| | 13 | |

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